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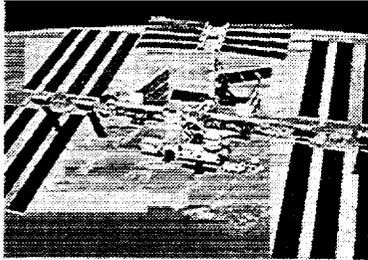
Hitchhiker On Space Station

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ABSTRACT

The NASA/GSFC Shuttle Small Payloads Projects Office (SSPPO) has been studying the feasibility of migrating Hitchhiker customers past present and future to the International Space Station via a "Hitchhiker like" carrier system. SSPPO has been tasked to make the most use of existing hardware and software systems and infrastructure in its study of an ISS based carrier system.



This paper summarizes the results of the SSPPO Hitchhiker on International Space Station (ISS) study. Included are a number of "Hitchhiker like" carrier system concepts that take advantage of the various ISS attached payload accommodation sites. Emphasis will be given to a HH concept that attaches to the Japanese Experiment Module - Exposed Facility (JEM-EF).

ISS HITCHHIKER STUDY OBJECTIVES

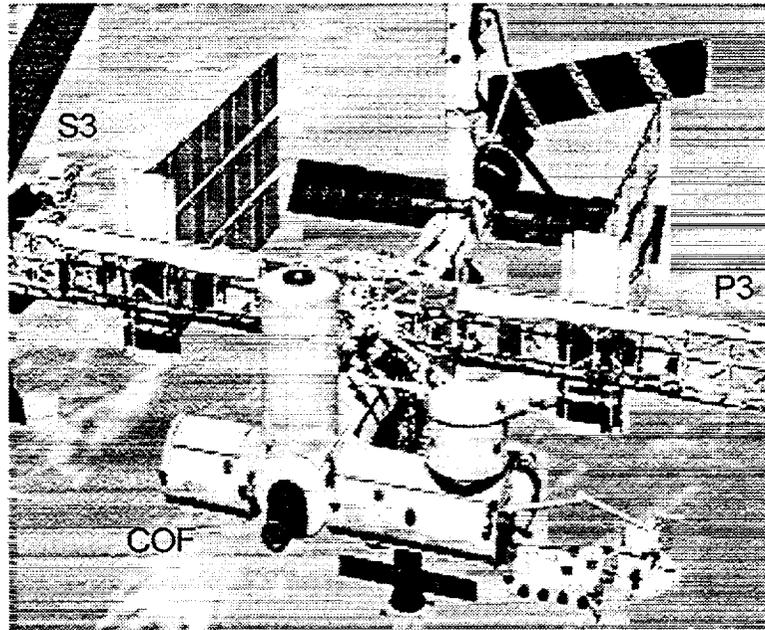
The objectives of the Hitchhiker on ISS study were to examine the potential for using existing or modified Shuttle Hitchhiker flight and ground systems, facilities, personnel, and general low-cost, quick reaction approach to support smaller scientific payloads on Space Station. Any such implementation should avoid duplicating any already planned ISS capabilities and allow for easy transition of existing Shuttle Hitchhiker customers to ISS.

EXISTING PLANNED SPACE STATION EXTERNAL PAYLOAD ACCOMMODATIONS

Existing plans for Space Station external payload accommodations were examined in detail in order to determine the most promising possibilities for complementary use of Hitchhiker derived systems and implementation approach. The current plans are summarized as follows:

The ISS has attachment latches (the Payload Attach System (PAS)) located on the main truss. Two are located on the nominal top (zenith - space facing) side of the starboard (S3) truss and a second pair are located on the bottom (nadir - earth facing) side. An additional set (upper and lower) of latches is located on the port side (P3) of the truss. The S3 locations are planned for scientific payloads while the P3 locations are initially planned for temporary storage and handling of non-operating payloads and other equipment but may eventually be used for operating payloads. Each electrically operated latch has a remotely operated connector providing 120vdc power, MIL 1553 data and command signals, and a fiber optic high rate data line which can be used periodically for scheduled downlink of accumulated data.

The truss mounts can handle payloads up to 11,000 lb. (5000Kg) up to 15 x 7.5 x 10 feet (4.6 x 2.3 x 3.0 m) in size.

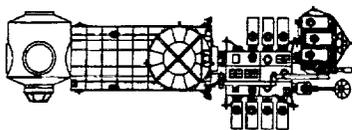
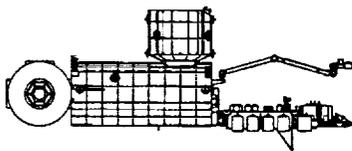


JEM-EF ELM-ES

ISS Payload Accommodations

The EXPRESS Pallet being developed by the Brazilian Space Agency is designed to mount to the truss. Each pallet can accommodate six pallet adapters while occupying one truss mount. The adapters are flat plates with a grid hole mounting arrangement for payload equipment up to 500 lb (227 Kg) and 34 x 46 x 49 inches (.9 x 1.2 x 1.3 m) in size. Adapters are provided with electrical accommodations including MIL 1553, 120vdc and 28vdc power, and an ethernet connection to a multiplexer which feeds the fiber optic system.

The European Columbus Orbiting Facility (COF) will have four external mounting positions for accommodating payloads on adapter plates similar to EXPRESS.



The Japanese Experiment Module - Exposed Facility (JEM-EF) is a "back porch" attaching to the Japanese pressurized module and has ten electrically operated latches for attaching payloads in various orientations. Two of the positions can handle 5500 lb (2500Kg) and the remaining eight can handle 1100 lb (500 Kg) with sizes of 72 x 40 x 31 inches (1.8 x 1.0 x .8 m). Electrical accommodations vary somewhat with mounting position and include 120vdc power, MIL 1553, and ethernet. Unlike the other mounts, JEM-EF provides fluid cooling. JEM has a manipulator arm with tool driving capability.

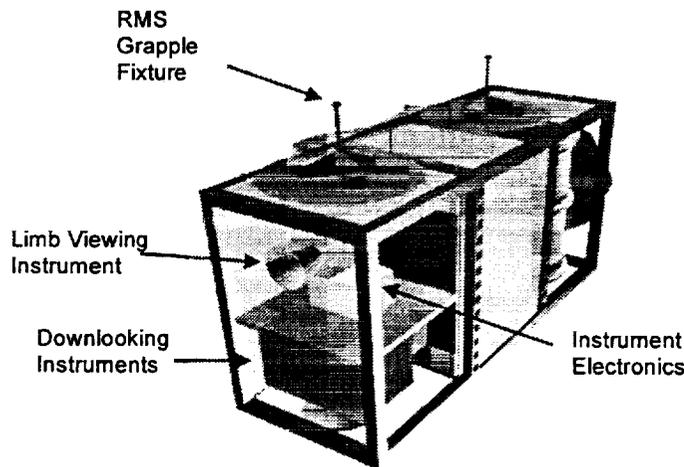
Various Shuttle "logistics" carriers are planned to transport payloads to and from station including the Brazilian Unpressurized Logistics Carrier (ULC), and Japanese Experiment Logistics Module - Exposed Section (ELM-ES). The Japanese H2 expendable launcher may also be used to launch JEM payloads and to destructively reenter payloads after their operational period if intact return is not required.

Payloads are installed and removed using extensive robotics including various "manipulator arms" similar to the Shuttle RMS. For ISS, new grasping and tool driving capabilities are being developed.

In addition to the four truss mounts, two COF adapter positions and five JEM-EF positions are assigned to NASA use.

ISS HITCHHIKER JEM-EF PAYLOAD BUS

The Hitchhiker carrier proposed for use with JEM-EF consists of a rectangular box structure. A Payload Interface Unit (PIU) on one end provides for latching to the JEM-EF platform and includes power, data, and fluid interfaces. A second latch interface on the side of the structure is used for attaching the structure to the upload carrier during Shuttle missions to and from ISS. A pair of grapple fixtures are also provided to allow the structure to be handed off between the Shuttle and Station or JEM RMS arms during installation maneuvers. Depending on the exact configuration of the latch it is possible that only one grapple fixture will be required.



ISS Hitchhiker JEM-EF Carrier

The structure is provided with adjustable shelves for accommodating various size instruments and instrument electronics boxes. Hitchhiker-type canisters may also be used to house instruments. Outer skins on the structure provide thermal treatment and can have aperture holes as required. In addition to multilayer insulation blankets or other thermal surfaces, thermostatically controlled louvers may be used to provide thermal control of the payload. High dissipation payloads may require use of the JEM fluid loop system for heat removal.

A power distribution system provides individually switched and current limited power for up to four instruments. Power is 120vdc but converters can be installed to provide limited amounts of 28vdc power if necessary.

A data system in the bus provides simple, easy to use, Hitchhiker type electrical interfaces for up to four instruments. The use of the Hitchhiker interface allows easy modification of existing instruments for flight on ISS and allows dual use of new instruments if desired. Instruments may connect to a local MIL-1553 bus or a local ethernet 10 Base T bus in addition to the Hitchhiker interfaces. A data storage system may also be provided depending on instrument requirements.

OTHER ISS HITCHHIKER ACTIVITIES

The Hitchhiker Program is also investigating the use of existing or modified Shuttle Hitchhiker equipment to support Shuttle launch or return of ISS payload equipment. This includes side-mount (GAS Beam) or cross-bay (MPRESS) equipment. The Program is also interested in supporting investigations which require both Shuttle and ISS support such as phased development of flight instrumentation. In addition, the Program is developing a database of ISS payload related documentation for support of investigators. A CAD system for supporting payload accommodations studies, proposal development, and field-of-view studies is also under development.

ISS HITCHHIKER INTEGRATION AND OPERATIONS PLAN

The ISS Hitchhiker Program will share GSFC resources, facilities, and personnel with the continuing Shuttle Hitchhiker Program. GSFC will provide interface management (including support for documentation, interface engineering, safety, launch and flight operations planning, and crew training) and perform instrument to carrier integration and checkout at GSFC in a manner similar to the Shuttle Hitchhiker Program. GSFC will also provide a control center for operating and monitoring the carrier systems and providing general support to investigators as required. Because ISS Hitchhiker payloads will operate for much longer periods than Shuttle Hitchhiker, it is anticipated that most investigators will want their own control center facilities to operate their instruments and acquire data during missions. These facilities will communicate directly with the ISS Payload Center at MSFC or NASDA.

ISS HITCHHIKER PROGRAMMATICS

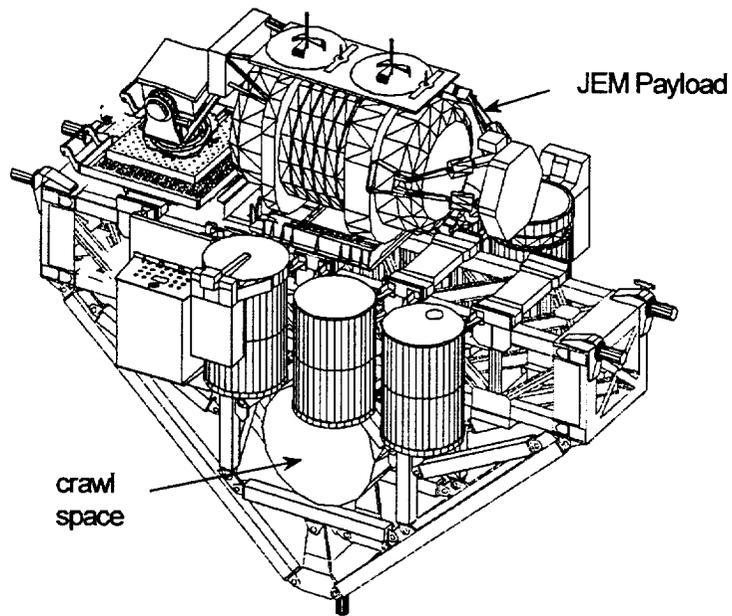
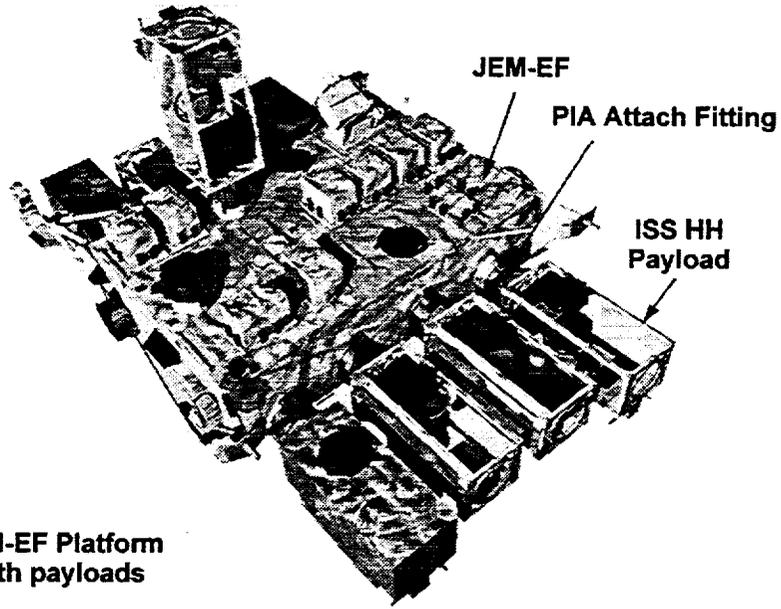
It is anticipated that future science flight opportunities announced by the NASA Offices of Earth and Space Science will include the option of proposing missions for flight on the ISS JEM-EF. Submitters can incorporate ISS Hitchhiker into their proposals. We expect that recurring standard Hitchhiker integration and operations activities will be provided at no cost to proposers in a manner similar to the existing Shuttle Hitchhiker services. However, because flight hardware will be utilized for a much longer period by ISS Hitchhiker users there may be a use fee. In addition, optional, non-standard, hardware or services will be priced on a case-by-case basis. The Hitchhiker Program is planning to support experimenter proposal development and feasibility work regarding ISS JEM Hitchhiker at no cost to the proposer. If a selected proposal utilizes ISS, existing NASA Headquarters and JSC procedures will handle ISS and Shuttle manifesting.

CONCLUSION

The U.S. assigned external payload space on JEM-EF represents approximately one-quarter of all the ISS external payload space available for use by U.S. investigators and is therefore an extremely valuable national resource. By providing simple, Hitchhiker style hardware and management interfaces for small payloads, the ISS Hitchhiker enables competitive, cost-effective science payloads to be proposed and flown using this resource.

ADDITIONAL INFORMATION

For additional Hitchhiker information call Gerry Daelemans at (301) 286-2193 or consult the ISS Hitchhiker web site at <http://ssppiss.gsfc.nasa.gov> or the Shuttle Hitchhiker web site at <http://sspp.gsfc.nasa.gov>.



Shuttle Hitchhiker Carrier Modified for JEM Payloads

